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reviewer has already in part expressed his opinion⁶ and Dr. Eastman's renewed arguments have not led him to alter his point of view.

The central argument against Dr. Eastman's theory of the dipnoan affinity of the Arthrodira seems to the reviewer to be that he lays too much stress on a single character—the resemblance of the crushing dentition of the ceratodonts to that of *Mylostoma* among arthrodires. This resemblance he interprets as an homology and makes it one of the cardinal arguments for relationship. But why may not this partial resemblance in dentition be a case of parallelism, of adaptation to similar food, in two widely different groups?—especially so in view of the wide differences between arthrodires and dipnoans in other regards, and because of the frequent occurrence among fishes of adaptations to a similar hard diet. It seems to the reviewer that a close examination of Dr. Eastman's argument for the homology of the ceratodont and arthrodiran dentitions, especially the exposition on pages 150–151, will hardly carry conviction to the mind of the critical reader.

But the establishment of homology between ceratodont and arthrodiran dentitions is the crucial point in Dr. Eastman's theory. Reject this central argument as not proved or, if you please, as *sub judice*, and little evidence remains, at least in the reviewer's opinion, to support the thesis of a genetic affinity between arthrodires and dipnoans. Some of the adduced evidence must, in fact, be ruled out of court as not material to the present case, for instance the question of the shape of the caudal fin⁷ or of the homology of certain skeletal elements.

Furthermore, as Professor Dean has recently urged, there are certain absolutely irreconcilable differences between arthrodires and subject see a review by Professor Bashford Dean in *SCIENCE*, July 12, 1907, p. 48.

⁶ *Mem. Amer. Mus. Nat. Hist.*, IX., 1906, pp. 126–128.

⁷ For, granted even that *Coccoosteus* had a diphyccercal tail, and that fact does not alter the balance of evidence, since a diphyccercal tail is not an exclusively dipnoan character.

dipnoans; for instance, the presence in all arthrodires of a complicated dorsal and ventral body-armor constructed on one plan and with complicated neck joints, and its absence in all dipnoans.

And again, the characters linking the arthrodires with the Ostracophores to which writers have again and again called attention within the past half century, are surely not dipnoan.

These are only some of the broader criticisms against Dr. Eastman's views on the affinity of the arthrodires. Did space permit, we might profitably examine certain of the subsidiary hypotheses and conclusions and point out minor difficulties and discrepancies which weigh against Dr. Eastman's main thesis. But enough has been said, we believe, to indicate some of the chief grounds for dissenting from our author's view that the Arthrodira are specialized dipnoans.

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Variations and Genetic Relationships of the Garter Snakes. By ALEXANDER G. RUTHVEN. United States National Museum, Bulletin 61, pp. 201. 1908.

In these days of minute analysis on the part of systematic zoologists, an acute and exact study of variation with a synthetic purpose comes as rest to the weary.

The courage displayed by Dr. Ruthven in giving reasons for his scheme of genetic relationships in this impracticable group can be best valued by other herpetologists who have ventured on the same task and have been carefully secretive as to how they did it. As one of these I may be privileged to both praise and criticize this excellent paper.

Nothing but good can be said of the method adopted by the author in carefully estimating the value of the characters commonly held to be specific in snakes, and of the painstaking care with which it has been followed to the end. It is an ingenious bit of demonstration, and one easily verifiable, which shows that reductions in the number of rows of dorsal scales as girth of body decreases in the in-

dividual snake, are brought about always by the dropping of certain definite rows, and are not promiscuous, and this observation leads on to the almost equally certain conclusion that specific variation in the scale rows follows the same sequence as in the case of individuals, and is correlated with girth of body. Outside of such sequence variation so rarely occurs that it is negligible. So also with the labial scuta, certain of which are present, absent or fused, in dependence upon head-length.

These results are of much interest and value, and will become more so with increasing knowledge of the processes which make up the so-called "laws of growth." But—and here criticism must take a hand—however surely the chapter on variation establishes these and other novel facts, the reviewer is not able to see that the proposition laid down by Dr. Ruthven as a guide to his phylogenetic lines of parallel development necessarily follows from them. The proposition in brief is that *Thamnophis* started out with the maximum number of dorsal rows known in the genus, and that the forms resulting from geographical extension are for the most part consequent on dwarfing, due to unfavorable environment—the whole course of species formation in the group being one of reduction, and the maximum of size being assumed to be *T. megalops*, of the Mexican plateau, with an occasional twenty-three rows. This is a necessary step to the author's final conclusion as to the original home of *Thamnophis*, but it is by no means certain that *megalops* in the average is really larger than *sirtalis* or *parietalis* of the north, and examples of the questionable form known as *biscutata*, from Oregon, are now and then found which also have twenty-three rows.

Dwarfing has undoubtedly been a factor in the formation of some species, as notably *butleri* and *leptocephalus*, but the evidence is not complete that it has been general. Indeed the fundamental postulate of the theory has more strain put upon it than it can bear, for in the light of what is known as to the relative abundance of garter snakes in different portions of their range, and of their habits, it is not easy to admit that all conditions en-

countered by them beyond the Sonoran habitat of *megalops*, must be regarded as unfavorable.

If variability in dorsal scales is related to size, and has become definitely limited as a physiological function of certain rows, it is altogether possible, and to the reviewer it seems probable, that the process of differentiation into species has been much more complex than the scheme so ingeniously developed by Dr. Ruthven, and that loss by dwarfing, and gain, perhaps by reversion, have played their respective parts over and again as species have adapted themselves during their migrations to unfavorable or favorable environments.

This leads to the one of Dr. Ruthven's conclusions which is most open to question, in that his four lines of descent in *Thamnophis* are traced back to northern Mexico as the center of origin of the genus.

As presented here there is incompleteness in the theory, for it requires the existing forms of garter snake to be left there, just as they are, in a sort of cul de sac, from which there is no further phyletic outlet. There is no guide possible, even to speculation, as to a common ancestral form, or as to the source from which the genus was derived.

Zoological geographers will be slow to believe that a group so largely dependent upon water is likely to have originated in an arid region, concerning which there is no reason to suppose that in geologically recent times it has been less dry than now. This general consideration is of little moment in Dr. Ruthven's opinion, but certain other probabilities remain, to be less easily dismissed.

From structure and life history there seems good reason to believe that *Thamnophis* came off from *Tropidonotus*, an almost cosmopolitan genus, and one in all certainty much older. Now *Tropidonotus* is distinctly not an inhabitant of the Sonoran region, and makes no approach to it nearer than the low gulf coast of Mexico, and as an intruder up the valley of the Rio Grande. There must be significance in the absence of posterior vertebral hypapophyses in all the genera of colubrine snakes which with fair certainty

may be assigned to a Sonoran origin. Nor is there one having keeled scales, except *Pityophis*, which appears to have inherited them from *Coluber*, and exhibits them now in weakness and instability indicating that they are being got rid of. I have shown elsewhere that hypapophyses and keeled scales are probably useful in swimming, to aquatic species. In both of these respects *Thamnophis* would be an anomaly among indigenous Sonoran genera, and its possession of both structures appears to be an argument of much weight on the side of its Austroriparian origin.

In matters of detailed taxonomy little need be said, especially when one admits the sway of the personal equation among specific characters. The author does present objections of some importance to the phylogenetic schemes devised by Professor Cope and the present reviewer, but it is to be remembered that the last of these, at least, was put forward as no more than a tentative hypothesis—a *ballon d'essai* as it were—and its author has no present inclination to make defense of all its details. But it must be said that parts of Dr. Ruthven's grouping are equally inadmissible. For instance, he combines with a long known Washington and Oregon form, *leptocephalus* (*ordinoides* in his nomenclature), garter snakes from the coast region of central California, usually recognized as *elegans*, which he excludes altogether from that portion of its range. This is not a happy conclusion, in view of the fact already recorded by me (*Proc. Academy of Nat. Sciences of Phila.*, 1903, p. 290), that I removed from the oviducts of a female from Santa Cruz Co., California, which would be, and indeed is assigned by Dr. Ruthven to *leptocephalus* (*ordinoides*), thirteen young, fully developed, twelve of which in color and scutellation are typical *elegans*, as defined by Baird and Girard. The snake to which Ruthven applies the name *elegans* is a species of the mountains and high plains properly known as *vagrans*.

Again, certain specimens of *elegans* from Santa Cruz Co. and neighboring portions of California, occur that are distinguishable with difficulty from *parietalis*, which Dr. Ruthven places on a quite different line of descent.

But I cheerfully turn away from fault-finding. The paper is admirably conceived, carefully executed, is original and fearless throughout, and systematic zoology would make large measure of gain if there were hope that it might serve as a finger-post to better methods in the study of variation. Here it deserves all praise.

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SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for July contains the following articles "A New Mendelian Ratio and Several Types of Latency," by George H. Shull; "The Leg Tendons of Insects," by C. W. Woodworth, in which the author notes that the fact that the leg tendons are cuticular invaginations, and therefore subject to replacement at each molt, has not, so far as he is aware, been published. A case of "Abnormal Incisors of *Marmota monax*" is described by Charles A. Shull, and "A Note on the Coloration of *Plethodon cinereus*" is given by Hugh D. Reed, who describes two unusually red individuals. Marian E. Hubbard gives the results of "Some Experiments on the Order of Succession of the Somites of the Chick," which show that not more than two somites can arise in front of the one first formed. Hervey W. Shimer discusses "Dwarf Faunas," concluding that the chief agency in their production is an abnormal habitat. This might come about by change in a normal habitat or by the extension of an animal's range into an unfavorable location. In "Notes and Literature" Charles A. Kofoid gives a clear and interesting résumé of "The Life History of the Eel."

The Zoological Society Bulletin for July notes the birth of a mountain goat in the Park, the first born in captivity. The parents were two of a herd of five secured by Director Hornaday in 1905, and born in May of that year. There is an account of the present status of the park showing that it ranks first in number of individuals represented in the collections, there being 4,034 animals living in the park. Under the head